


Pavement Breakout Session - 2006 CEC



Pavement Breakout

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What do we hope to accomplish?

- Concepts of Pavement Design
- Asphalt Pavements
 - Recent Specifications Changes
 - Determining Lots for Density
 - Limited Production Procedures
- Concrete Pavements
 - Recent Specification Changes
 - Sawing and Sealing of Joints
 - Maturity Testing for Opening to Traffic
 - Hands-on Demonstration of Maturity Method

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Specification Updates

- Increased Verification Samples (V) from 5% to 10%
- Decreased Comparison Samples (QA) from 10% to 5%
- Limited Production for Smoothness
 - Contractor required to go on Limited Production after 5 days of Poor Ride Quality.

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Specification Updates

Article 609-5 Contractors QC System

- Subarticle 609(D)(2) Pavement Samples (Cores)
- Where samples have been taken, clean the inside surfaces of the sample hole, dry, properly apply tack coat, place and compact new mix of the same type to conform with the surrounding area **within one working day** of the sample being taken. Use a circular tamp or other approved device to achieve compaction.

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Specification Updates

Article 609-5 Contractors QC System

- Subarticle 609(E) Documentation
- If mix is removed due to unsatisfactory laydown, payment will be made for the actual quantities of materials required to replace the removed quantities, not to exceed the original amounts.

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Specification Updates

Use a Material Transfer Vehicle whenever PG 76-22 is used:

- Open Graded Friction Coarse
- S9.5D
- S12.5D

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Specification Updates

Intersection paved during one days production are now considered a separate lot, therefore:

- a minimum of 3 cores samples are required from that lot or,
- a minimum of 5 nuclear gauge readings are required from that lot.

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Specification Updates

Density control sampling and testing should be performed on pavement used for wedging when designated on the typical sections and when directed by the Engineer. Test sites/sample locations on wedging shall be where pavement thickness meet or exceed the following:

- Surface mixes 1-1/2" or greater
- Intermediate mixes 2-1/2" or greater
- Base mixes 3-1/2" or greater

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Determination of "Lots"


Density is accepted on a lot by lot basis.

A lot will consist of 1 day's production of a given JMF for a given contract. Separate lots will be established for:

- Individual Map sections
- Individual paving operations "Crews"
- Different layers of the same mix type
- Control Strips placed during limited production

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Determination of “Lots”

In addition Separate lots will be established for :

- New Construction Category
- Other Construction Category

The Engineer will determine the final category and final quantity of each lot.



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“New” Construction Category

MUST MEET ALL 3 of the following :

- 1) Pavement must be placed on **NEW**:
 - Aggregate Base or Soil Base compacted to a specified density, or
 - Asphalt mix layer (excluding wedging/leveling)
- 2) Pavement must be within a designated travel lane which is to be the final traffic pattern
- 3) Pavement must be 4’ or wider



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“Other” Construction Category

Any Pavement **Not Meeting All Three** Requirements for “New” Construction




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**EXAMPLES
of
“New” and “Other”
Categories**


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“New” or “Other” Category?
**Placing of Final Surface on newly placed
S9.5C layer on full width travel lanes of US 70**

- 1) Asphalt placed on a new base or new asphalt layer ?
- 2) Within a designated travel lane which will be the final traffic pattern?
- 3) 4' or wider ?

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“New” or “Other” Category?
**Placing of Final Surface on newly placed
S9.5C layer on full width travel lanes of US 70**

- 1) Asphalt placed on a new base or new asphalt layer ? **YES**
- 2) Within a designated travel lane which will be the final traffic pattern? **YES**
- 3) 4' or wider ? **YES**

All 3 are YES therefore “NEW” Construction


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“New” or “Other” Category?
Placement 4 feet of I 19.0 B on a newly placed ABC layer for a shoulder

- 1) Asphalt placed on a new base or new asphalt layer ?
- 2) Within a designated travel lane which will be the final traffic pattern?
- 3) 4' or wider ?



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“New” or “Other” Category?
Placement 4 feet of I 19.0 B on a newly placed ABC layer for a shoulder

- 1) Asphalt placed on a new base or new asphalt layer ? **YES**
- 2) Within a designated travel lane which will be the final traffic pattern? **NO**
- 3) 4' or wider ? **YES**

All 3 are not YES therefore “OTHER” Construction




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“New” or “Other” Category?
Resurfacing US 74 with a single 1.5 inch lift of S9.5C

- 1) Asphalt placed on a new base or new asphalt layer ?
- 2) Within a designated travel lane which will be the final traffic pattern?
- 3) 4' or wider ?



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“New” or “Other” Category?
Resurfacing US 74 with a single 1.5 inch lift of S9.5C

- 1) Asphalt placed on a new base or new asphalt layer ? **NO**
- 2) Within a designated travel lane which will be the final traffic pattern? **YES**
- 3) 4' or wider ? **YES**

All 3 are not YES therefore “OTHER” Construction


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Why is it important to know whether pavement is “New” or “Other” Construction?

- “New” construction pavement which does not meet the minimum specification requirements but is reasonably acceptable is paid for at a reduced price in accordance with Article 610-13.
- “Other” construction pavement is typically assessed 1/2 of the penalty.

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Limited Production Procedures

for

Nuclear and Core Density Control

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Density Limited Production

- When is Limited Production required?
 - 2 consecutive failing lots per mix type, **excluding** lots representing individual resurfacing map sections or portions there of.
 - 3 consecutive failing lots per mix type, with each representing individual resurfacing map sections or portions there of, or
 - 2 consecutive unacceptable nuclear control strips per mix type.


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Density Limited Production

- Limited Production is Defined as:
 - The production, placement and compaction of a sufficient quantity of mix to construct only a 300' control strip plus 100' of pavement adjacent of each end of the control strip.

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Density Limited Production

Limited Production Applies for Each of the Following:

1. Mix Type
2. Contract
3. Paving Crew


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Density Limited Production

- The Contractor shall remain on Limited Production until satisfactory results are attained or two control strips have been attempted without achieving acceptable results, whichever occurs first.
- Still not achieving density at this point?
 - Production of the asphalt mix shall cease until such time as the cause of the failing density test results can be determined.



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Density Limited Production

- Failure by Contractor to operate under the limited production procedures?
 - **Mix** for the failing lots and all mix produced after the required stop point **is** considered **unacceptable**.
 - The **pavement shall be removed and replaced** with material which complies with the specifications, unless otherwise approved by the Engineer.



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How the Ice Age Started



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Competition at its finest!



Division 7 Concrete Pavements and Shoulders

- Recent Specification Changes
- Sawing and Sealing of Joints
- Inspection responsibilities for concrete pavement
- Maturity Testing for Opening to Traffic
- Hands-on Demonstration of Maturity Method

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Specification Updates

Article 700-4 Preparation of Subgrade and Base

- Dampen the surface of the base at the time the concrete is placed. Sprinkle the base when necessary to provide a damp surface. **Ensure that no free water or ponding is present at the time of concrete placement.** Correct all damaged areas in the subgrade or base prior to placing concrete.

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Specification Updates

Article 700-4 Preparation of Subgrade and Base

- Do not allow traffic on the underlying asphalt courses other than necessary local traffic and that developing from the operation of essential construction equipment as may be authorized by the Engineer. **Repair any defects that develop in the underlying asphalt courses or any damage caused by local or construction traffic acceptably at no cost to the Department.**



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Specification Updates

Article 700-4 Preparation of Subgrade and Base

- Unless otherwise approved, utilize and maintain a **braided metal cable stringline reference** to be used to control the profile and alignment of the concrete pavement. Monitor the stringline for accuracy and tautness. **Set Pins at a maximum distance of 50 feet apart. When located on a vertical curve, set pins at a maximum distance of 25 feet.**




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Specification Updates

Article 700-5 Placing Concrete

- Temperature Limitations
 - Stop paving when ambient temperature reaches 35°F
 - Stop paving when ambient temperature reaches 90°F



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Specification Updates

Article 700-6 Vibrating Concrete

- The Contractor shall furnish an **electronic vibrator monitoring device**, displaying the operating frequency of each individual vibrator on the paving equipment.




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Specification Updates

Article 700-8 Protection of Portland Cement Concrete Pavement.

- Cold Weather
 - Insulate the pavement to prohibit the concrete from cooling at a rate greater than 5°F per hour.
 - Prevent the surface temperature from dropping below 40°F during the curing period.




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Specification Updates

Article 700-8 Protection of Portland Cement Concrete Pavement.

- Hot Weather
 - When the anticipated daily high temperature is above 80°F, place the concrete at the coolest temperature practical.



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Specification Updates

Article 700-8 Protection of Portland Cement Concrete Pavement.

- Rain
 - When rain appears imminent, stop all paving operations, and have all available personnel protect the surface of the unhardened concrete.




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Specification Updates

Article 700-9 Curing

- Use a curing period of **7 curing days** for **pozzolan mix designs**.
- Use a minimum application rate of 0.0067 gallons per square foot when the curing application equipment is mechanically operated.
- **Contractor shall provide a inline flow-metering device to ensure the proper application rate is provided.**
- No puddling or ponding is permitted.



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Specification Updates

Article 710-10 Measurement and Payment


- The pay factor for pavement achieving a flexural strength in **28 days of 650 psi** or greater is 100%.
- The pay factor for pavement achieving a flexural strength in 28 days between 600psi and 650 psi is determined by the following formula:

Pay Factor (%) = 100 - (650 - PSI)
(pay factor rounded to nearest tenth of one percent)



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Specification Updates

Article 700-11 Joint Construction

- Utilize an **early entry dry-cutting sawing system**.
- Construct the joint groove using a 1/8 inch saw blade to a minimum depth of 3 inches.
- Saw the concrete pavement as soon as it can support the weight of the equipment and operator without disturbing the final finish. Complete all saw cutting before **seven hours** has elapsed from the time of concrete placement.




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Specification Updates

Article 700-13 Use of New Pavement or Shoulder

- Traffic or other heavy equipment will not be allowed on the concrete pavement or shoulder until the estimated flexural strength of the concrete using the **maturity method** has exceeded 600 psi unless otherwise permitted.



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Specification Updates

Article 700-15 Acceptance Tests for Concrete

- Determine the flexural strength of concrete by testing a minimum of one set of two 6"x 6"x 20" beams at **28 calendar days**.



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Specification Updates

Article 710-7 Final Surface Testing

- construct the concrete so that the completed concrete pavement surface has a profile index (PI) along any line tested not exceeding **25 inch per mile**, as determined with a **0.00 inch blanking band**, over any 600 foot section of pavement.

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Joint Construction

- Utilize an Early Entry dry-cutting sawing system.
- Have an adequate amount of sawing equipment available to match the production and concrete paving operations.

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Joint Construction

- Ensure the saw cuts are placed over the dowels
 - Line up paint marks on base
 - Snap a chalk line
 - Aligned with joints in adjacent lanes

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Joint Construction

- Construct a joint groove using a 1/8" (3mm) saw blade to a minimum of 3" (75mm) in depth.
- Perform sawing as soon as the concrete has hardened sufficiently without undercutting, spalling and raveling to control random cracking.
- Complete all initial saw cutting before seven (7) hours has elapsed from the time of concrete placement.

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Joint Construction

- Cut as soon as pavement can support the weight of the saw and operator without disturbing the final surface.
- Saw joints in a neat, vertical straight line without chipping, spalling, tearing, or disturbing the final finish.
- Immediately reapply any curing membrane that is damaged by the sawing operations.

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Joint Construction

- Measure and document depth of initial cut
- Verify correct alignment
- Random Cracking may occur when:
 - Not sawed deep enough
 - Sawed too late
- Prior to placing adjacent lanes or shoulders, cover the transverse joint opening

Joint Construction

- Second saw cut creates a reservoir for the backer rod and sealant
- Transverse Joints
 - 3/8 inch wide
 - 1.5 inch deep
- Longitudinal Joints
 - 1/4 inch wide
 - 1.5 inch deep

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Sealing Joints

- Remove the slurry
- Sand blast to clean
- Install backer rod
- Apply low modulus silicone sealant to clean dry joints

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Mob Car?

FunMansion.com



The Maturity Concept

- The strength of a given concrete mixture that has been properly placed, consolidated, and cured, is a function of its age and temperature history.

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The Maturity Concept

- The maturity of concrete can be defined as its age multiplied by the average temperature (above freezing) that it has maintained.
- Concrete of the same mixture at the same maturity has approximately the same strength whatever combination of temperature and time goes to make up that maturity.

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The Maturity Concept

$$M(t) = \sum (T_a - T_o) \Delta t$$

M(t) = Temperature-time factor at time t,
degree-hours

Δt = Time interval, hours

T_a = Average concrete temperature
during the time interval (°C)

T_o = Datum temperature (-10°C)

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Benefits of Maturity

- Identifies earliest possible opening to construction traffic and public use
- Allows determination of optimum time to saw joints
- Facilitates fast-track applications
- Requires fewer specimens to fabricate and test, thus reducing QA costs

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Benefits of Maturity


- Improves public relations by reducing closure time for construction
- Improves safety by reducing the exposure time of the work zone area to traffic
- Non-destructive approach for estimating the strength of concrete
- More representative of in-situ conditions



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NCDOT's Maturity Method Test Procedure



Three Steps to Maturity

1. Develop a Flexural Strength-Maturity Relationship
2. Verify the Flexural Strength-Maturity Relationship
3. Estimate in-place Flexural Strength

For Opening to Construction Traffic
Not for Acceptance



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Equipment Needed

- Commercial Maturity meters that automatically compute and display the maturity index in terms of a temperature-time factor, TTF.



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Equipment Needed

- The Engineer may allow the use of a multi-channel meter when several thermocouples are in use.
- Meters should be protected from excessive moisture, theft, and the LCD display protected from direct sunlight.
- Thermocouple wire shall be greater than or equal to 20 awg.

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Calibration of Meters

- The maturity meter should be checked prior to use and bi-monthly against a calibrated thermometer or other calibrated meter to ensure accurate temperature.
- Compare the indicated result with the known temperatures.
 - 50°F
 - 70°F
 - 115°F

The meter should be accurate within $\pm 2^\circ\text{F}$.

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Other Equipment Needed

- 6" x 6" x 20" Beam Molds
- Shovels (Square Point)
- Rubber hammers
- Wood Floats
- Rainhart Beam Breaker
- Hand held thermometers
- Type T thermocouple wire (20awg Min.)
- Connectors

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Other Equipment Needed

- Slump Cone
- Air Pot
- Scales (for Unit Weight)
- Scoops




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Maturity Method Requirements

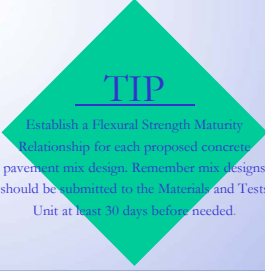
- Precaution: When the concrete temperature is below 50°F, maturity strength development will cause over extended TTF values.
- Development of flexural strength-maturity relationship should be performed on concrete with temperatures above 50°F.




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Developing a Flexural Strength-Maturity Relationship



Establish a Flexural Strength Maturity Relationship for each proposed concrete pavement mix design. Remember mix designs should be submitted to the Materials and Tests Unit at least 30 days before needed.



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Developing a Flexural Strength-Maturity Relationship

- The materials and proportions detailed in the concrete pavement mix design shall be the same as those to be used on the project.
- The minimum size of each batch shall be approximately 4 cubic yards.

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Developing a Flexural Strength-Maturity Relationship- The Steps

Step 1

Prepare a minimum of 20 beams.
Additional beams should be cast to avoid having to repeat the procedure.

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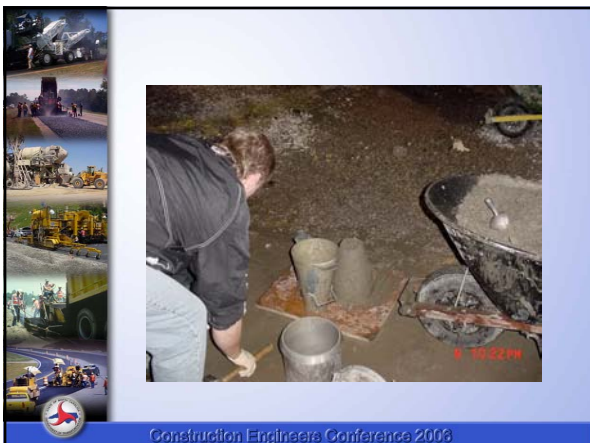
Developing a Flexural Strength-Maturity Relationship-The Steps

Step 2

Sample and test each batch of fresh concrete

- Concrete placement temperature
- Slump
- Air content (Unit weight)

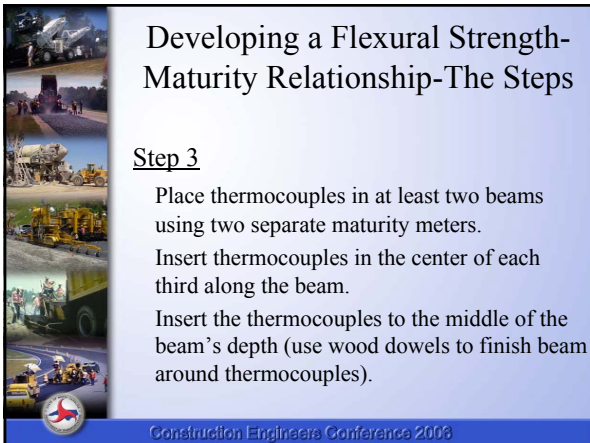
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Developing a Flexural Strength-Maturity Relationship-The Steps

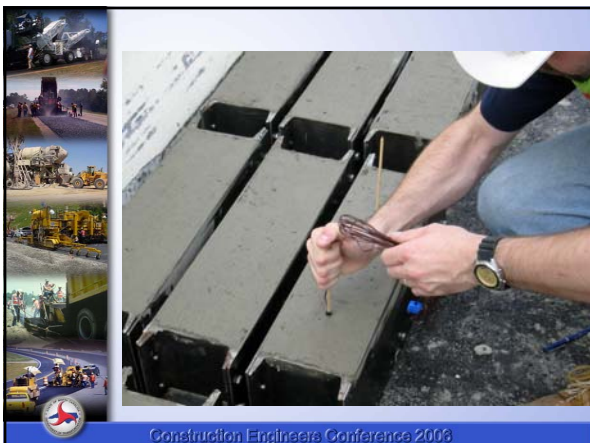
Step 3

Place thermocouples in at least two beams using two separate maturity meters.

Insert thermocouples in the center of each third along the beam.


Insert the thermocouples to the middle of the beam's depth (use wood dowels to finish beam around thermocouples).

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Developing a Flexural Strength-Maturity Relationship-The Steps

Step 3 (Continued)

- Connect the thermocouples to the maturity meters as soon as possible after thermocouples have been inserted
- Activate the maturity meters, and do not disconnect the meters.
- Data collection must be uninterrupted.

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Developing a Flexural Strength-Maturity Relationship-The Steps

Step 4

- Cure the concrete beams
 - Initial cure 24 to 48 hours (60° to 80°)
 - Remove from forms, mark, & grind off lips
 - Place beams in the waterbath for duration of curing ($73^{\circ} \pm 3^{\circ}$)
- Be careful of temperature while curing.

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Developing a Flexural Strength-Maturity Relationship-The Steps

Step 4

- Cure the concrete beams
 - Initial cure 24 to 48 hours (60° to 80°)
 - Remove from forms, mark, & grind off lips
 - Place beams in the waterbath for duration of curing ($73^{\circ} \pm 3^{\circ}$)
- Be careful of temperature while curing.

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Developing a Flexural Strength-Maturity Relationship-The Steps

Step 5

- Perform flexural testing at ages **1, 3, 5, 7, 14, and 28 days.**
 - Additional specimens and test ages may be required at the discretion of the Engineer.
 - Test 3 beams at each age and compute the average flexural strength.
 - The specimens with thermocouples should not be tested.

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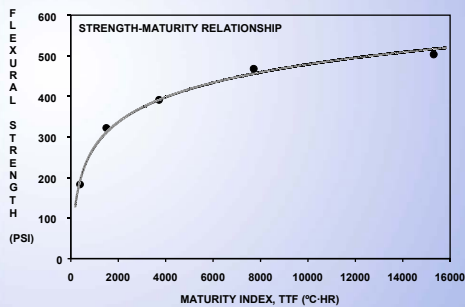
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Developing a Flexural Strength-Maturity Relationship-The Steps

Step 7

- Plot the average flexural strengths as a function of the average maturity values, with data points shown.
- Calculate a logarithmic best-fit curve through the data points
- Record the equation of the curve as well as R^2 value.

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Developing a Flexural Strength-Maturity Relationship-The Steps

Step 7 (Continued)

- The resulting curve is the flexural strength-maturity relationship to be used for estimating the strength of the concrete mixture placed in the field.
 - The R^2 value indicates the reliability of the flexural strength-maturity relationship.
 - Results should produce a R^2 value of no less than 0.90.
 - Examine for data for outliers, incorrect beam break readings, or incorrect maturity meter readings if the R^2 value is less than 0.95.

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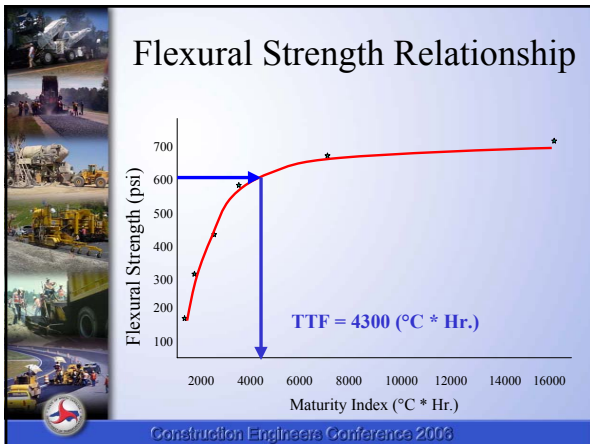



Developing a Flexural Strength-Maturity Relationship-The Steps

Step 8


- Determine the Temperature-Time Factor corresponding to the Strength Maturity Relationship at 600 psi, TTF.

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Verifying the Strength – Maturity Relationship



TIP

Verifying the Strength - Maturity Relationship

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Verifying the Strength – Maturity Relationship

The Contractor should verify the flexural strength-maturity relationship on the first day's production and at a minimum of every 10 calendar days.

- The Department should verify 10% of the contractor's tests.

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Verifying the Strength – Maturity Relationship

Step 1

Test each batch of fresh concrete for

- Slump
- Air content
- Concrete temperature

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Verifying the Strength – Maturity Relationship

Step 2

- Make a minimum of four test beams in accordance with ASTM C 31.

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Verifying the Strength – Maturity Relationship

Step 3

- Instrument thermocouples in one specimen at the center of each third along the beam.
- Insert the thermocouple to the middle of the beam's depth.

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Verifying the Strength – Maturity Relationship

Step 3 Continued

- Connect the thermocouples to the maturity meter.
 - Do not disconnect the maturity meter as data collection must be uninterrupted.
- The instrumented beam should not be tested unless needed and should be tested last the case of a defective beam.

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Verifying the Strength – Maturity Relationship

Step 4

- Cure all the specimens together in accordance with ASTM C 31.

Step 5

- Break verification beams as soon as the specimens have attained the required TTF from the maturity curve

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Record Log to Verify Strength-Maturity Relationship⁽¹⁾

Control: _____ Technician: _____
 Project: _____ Member: _____
 Highway: _____ Item No.: _____
 Engineer: _____ Cons. Class/Spec. No.: _____
 Contractor: _____ Date/Time Batch: _____
 Producer: _____ Location of Sampling: _____

Meter No.		Specimen 1:				Specimen 2:								
Batch No. (internal laboratory control number): _____														
Air Temp. at Placement		°F _____				°C _____								
Concrete Temp. at Placement		°F _____				°C _____								
Slump		inches _____				mm _____								
Air Content		% _____				% _____								
Required Strength of the Member:		psi _____				_____								
Required TTF of the Member:		°C-hr _____				_____								
Operations														
Date	Time ⁽²⁾ (hr:min)	Instrumented Specimens for Monitoring Maturity						Strength Test Results (psi)				Percent Difference ⁽³⁾		
		Specimen 1		Specimen 2		Average Value								
		Cons. Temp (°C)	TTF (°C-hr)	Cons. Temp (°C)	TTF (°C-hr)	Average Temp (°C)	Predicted Strength (psi)	1	2	3	Avg.			
Comments:														

Note (1) Attach copy of batch ticket
 Note (2) Perform compression or flexural strength tests, as appropriate, when (a) the specimen achieves the TTF corresponding to the design strength, or (b) the required TTF of the member is achieved in the field
 Note (3) % Difference = [(Average Strength – Predicted Strength)/Predicted Strength] x 100



Verifying the Strength – Maturity Relationship

- If the average value of the three validation beams is less than 550 psi:
 - Maturity curve is **not** validated
 - Suspend early opening of traffic
 - New maturity relationship is required

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Verifying the Strength – Maturity Relationship

- If the average of the beams is between 550 psi and 660 psi:
 - original curve is considered validated
 - Use the required TTF to open pavement to traffic

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Verifying the Strength – Maturity Relationship

- If the average value of the beams is greater than 660 psi, a new maturity curve may be required.
 - Early opening to traffic is allowed on pavement

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Verifying the Strength – Maturity Relationship

Step 5 (continued)

- If the test results indicate a new curve must be developed, this should be done in a timely manner.

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Verifying the Strength – Maturity Relationship

- Factors requiring a new flexural strength–maturity curve.
 - Any changes in plant operations
 - Batching procedures
 - Material sources
 - Mixture proportions

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Estimating In-Place Strength

TIP

Estimating In-Place Strength is a very important step. It all depends on your initial Maturity curve. Remember that all parties making and breaking beams, and Maturity testing shall be NCDOT P.C.C. Placement Certified.

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Estimating In-Place Strength

- Verify batching operations are in accordance with the approved mix design for which the maturity relationship was established.
 - Certified Portland Cement Concrete Pavement Technician should confirm the batching operation is in compliance.

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Estimating In-Place Strength

Step 1

- Insert temperature probes or sensors within the last 100 feet (30 m) of each day's production

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Estimating In-Place Strength

Step 2

- Embed the thermocouples in the fresh concrete at the mid-depth of the concrete slab at least 2.5 feet (0.8 m) from the edge of the pavement.
 - Thermocouples should not be located near tie bars or dowel bar assemblies.

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Estimating In-Place Strength

Step 3

- As soon as practical and while the concrete is still plastic insert the thermocouple wires into and activate the maturity meter(s).
 - Uninterrupted data collection
 - Do not disconnect the maturity meters until the required maturity values are achieved.

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Estimating In-Place Strength

Step 4

- Read the maturity meter daily
- Record maturity data on a permanent data sheet.
 - The data sheet should show the required flexural strength and TTF



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[illegible]

Estimating In-Place Strength

Step 5

- Maturity meters should be read in the presence of the Engineer or his representative.
- If the maturity value is equal to or greater than the required TTF, record the actual maturity index value.
- Remove the meter and clip thermocouple wires at the concrete surface.
- Pavement may be opened to traffic



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Maturity Testing - What's Important !!!!

- Establish a Flexural Strength Maturity - Relationship for each proposed concrete pavement mix design.
- Proportions should be the same at Mix Design as during construction.

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Maturity Testing - What's Important !!!!

- Remember mix designs should be submitted to the Materials and Tests Unit at least 30 days before needed.
- All paperwork should accompany your mix design Aggregate information.

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Maturity Testing - What's Important !!!!

- When the curve is established and the TTF is has been estimated, then the In-Place strength can be estimated.
- All installation of thermocouples and readings be made with the Resident Engineer or his representative present.

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Maturity Testing - What's Important !!!!

- Verify the maturity curve on on the first day's production.
- Both the Contractor and NCDOT personnel shall complete their work correctly.
- Work by the Maturity test procedure as closely as possible.

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Maturity Meter Operations

6 Menus:

- Present Values
- Help Information
- Recording Control
- Viewing Recorded Data/Meter Status
- Parameter Setup
- Recorded data Output (Communications)

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Hands On Demonstration

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Maturity Meter Operations

Recording Control (Press <REC>):

- Start Recording
- Stop Recording
- Erase

Use the <UP> and <DOWN> arrow keys to change the function selected within each menu.

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Maturity Meter Operations

Viewing Recorded Data (Press <VIEW>):

- Select Channel Number.
- Use the <UP> and <DOWN> arrow keys to scan back and forth in the recorded data:
 - Hour Number
 - Temperature
 - Temperature-time factor
 - Equivalent age factor

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Maturity Meter Operations

Viewing Meter Status (Press <VIEW>, <DOWN>):

- Available Memory
- Memory Used
- Battery Voltage
- Memory and clock backup circuit integrity.

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Maturity Meter Operations

Recorded Data Output (Press <VIEW> twice):

- Output data
- Transfer Out
- Transfer In
- Modem Transfer


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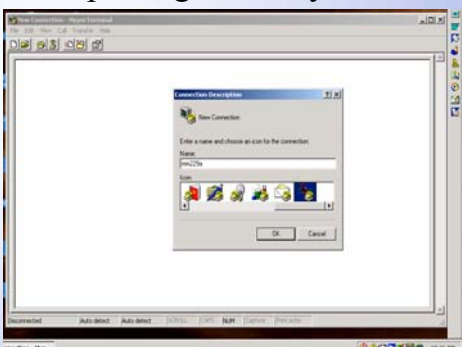
Importing Maturity Data



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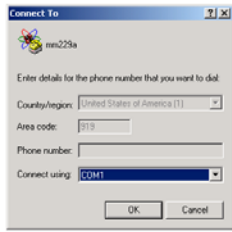
Importing Maturity Data



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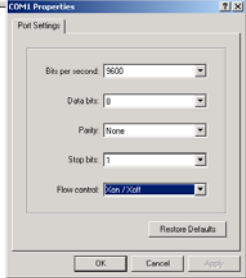
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Importing Maturity Data



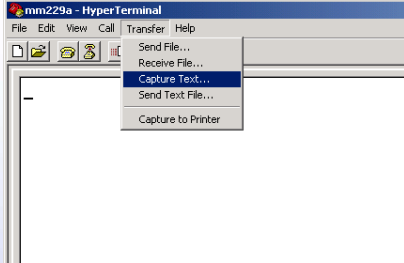
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Importing Maturity Data



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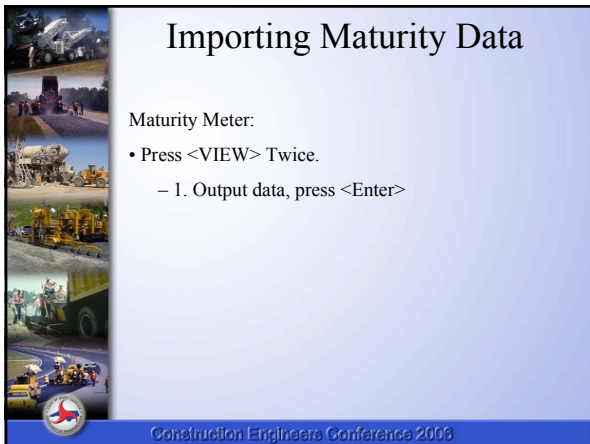
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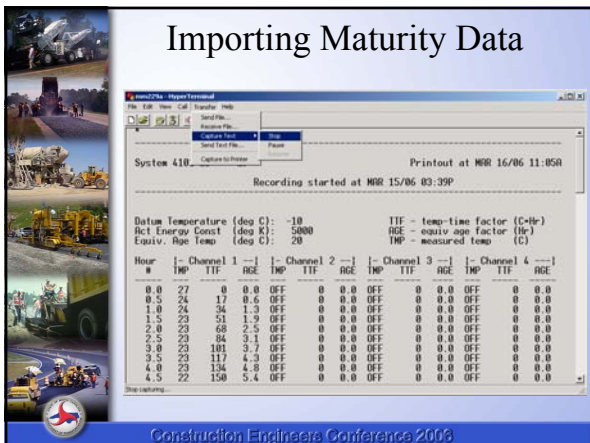


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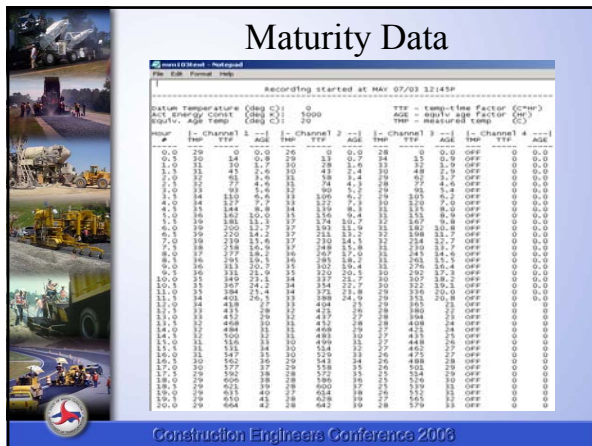
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Pavement Design

Clark Morrison
Pavement Management Unit



Pavement Design

- What is Pavement Design?
- What Information do we Need?
- Pavement Design
- What is the Process?
- Things are Changing



What is Pavement Design?

- Selection of layer material type
- Selection of layer thickness



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What Information Do
We Need To Do
A Pavement Design?



What Information Do We Need to
Do a Pavement Design?

- Roadway Information
 - Type of Roadway (rural vs urban, freeway vs. open access)
 - Number of Lanes
 - Location (for climate data)



What Information Do We Need to
Do a Pavement Design?

- Traffic Information
 - Current ADT
 - Future ADT
 - Percent Duals and TTST
 - Converted to ESALs Over Design Life



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Truck Loading Factors

	Dual Tire Trucks	Tractor Trailers
Rural freeway	0.30	1.15
Rural other	0.30	0.95
Urban freeway	0.30	0.85
Urban other	0.25	0.80



What Information Do We Need to Do a Pavement Design?

- Soils Information
 - Strength/Stiffness of Soil - CBR/SSV
 - Subgrade Stabilization Recommendations



What Information Do We Need to Do a Pavement Design?

- Information on Existing Pavement (if it will become part of the new pavement)
 - Pavement Thickness and Composition
 - Pavement Condition



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Pavement Design

- Pavement Thickness
 - We use 1972 AASHTO Design Procedure
 - An empirical procedure based on the ASSHO Road Test



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Pavement Design

- Material Type
 - Superpave material type based on level of traffic



Superpave Traffic Limits

Mix Type	ESAL Range (Million ESALs)
SF9.5A	Less than 0.3
S9.5B, I19.0B B25.0B	Less than 3
S9.5C	3 to 10
S12.5C, I19.0C	3 to 30
B25.0C	Greater than 3
S9.5D, S12.5D, I19.0D	Greater than 30



What is the Process for
Pavement Design?



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The Pavement Design Process

- Roadway Design sends a request to Pavement Management
- Pavement Management requests an investigation from Geotechnical Unit
 - Soils Data
 - Stabilization Recommendation
 - Existing Pavement Cores



The Pavement Design Process

- Pavement Management tests existing pavement (FWD test)
- Pavement Design Alternatives are prepared
 - Initial Cost
 - If concrete is considered, Life-Cycle Cost



The Pavement Design Process

- Review Sheet is prepared
- Input from DCE is requested



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[illegible]

The Pavement Design Process

- Pavement Review Committee meets, alternative is chosen
- Pavement Management issues Final Pavement Design Memo
- Roadway Design incorporates pavement design into plans
- Final Field Inspection



The Pavement Design Process

- Opportunities for Input or Questions from Construction Folks
 - Pavement Review Committee
 - Final Field Inspection
 - After Let
 - Stabilization, Layer thickness, Mix type, Developer widening, Shoulder thickness, etc.
 - **Contact Pavement Management Unit, Clark Morrison 919-250-4094**



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Things are Changing

- Pavement Design in the Project Development Process
- Movement to Mechanistic-Empirical Pavement Design



The End